CEMENT AND LIME MANUFACTURE

VOL. XXIX. No. 6 NOVEMBER, 1956 Price 1s. Annual subscription 6s. ($1.30 in Canada and USA)

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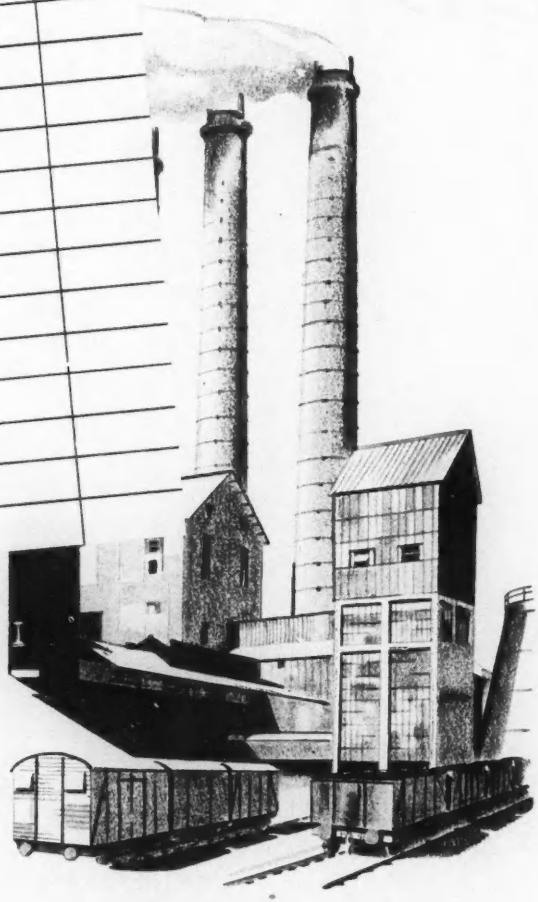
Refractories



Anistie, Nettle and Stein 50 Firebricks.

Burning Zone —
Stein 63 and Stein 70 High Alumina Bricks and Stein Mag C Magnesite Chrome Brick.

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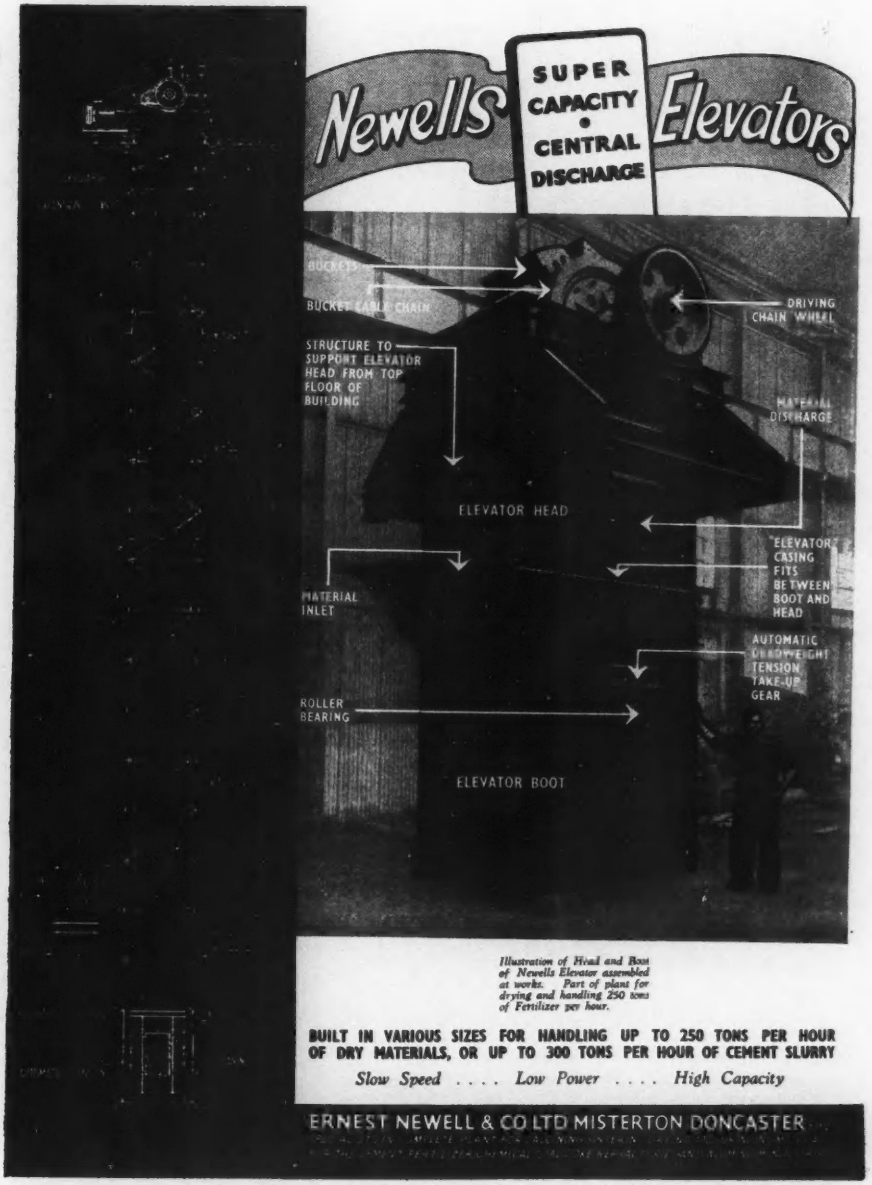

Illustration of Head and Boot of Newells Elevator assembled at works. Part of plant for drying and handling 250 tons of Fertilizer per hour.

BUILT IN VARIOUS SIZES FOR HANDLING UP TO 250 TONS PER HOUR OF DRY MATERIALS, OR UP TO 300 TONS PER HOUR OF CEMENT SLURRY

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STEIN

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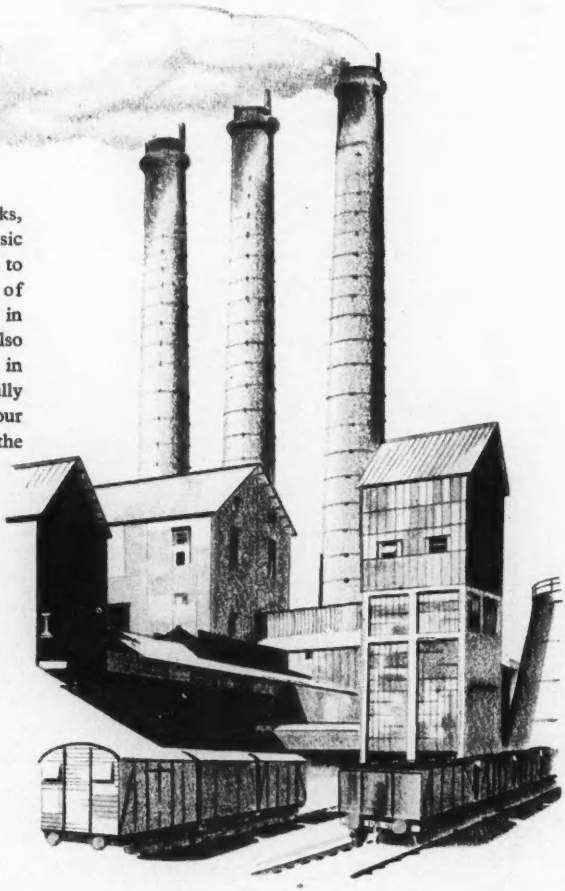

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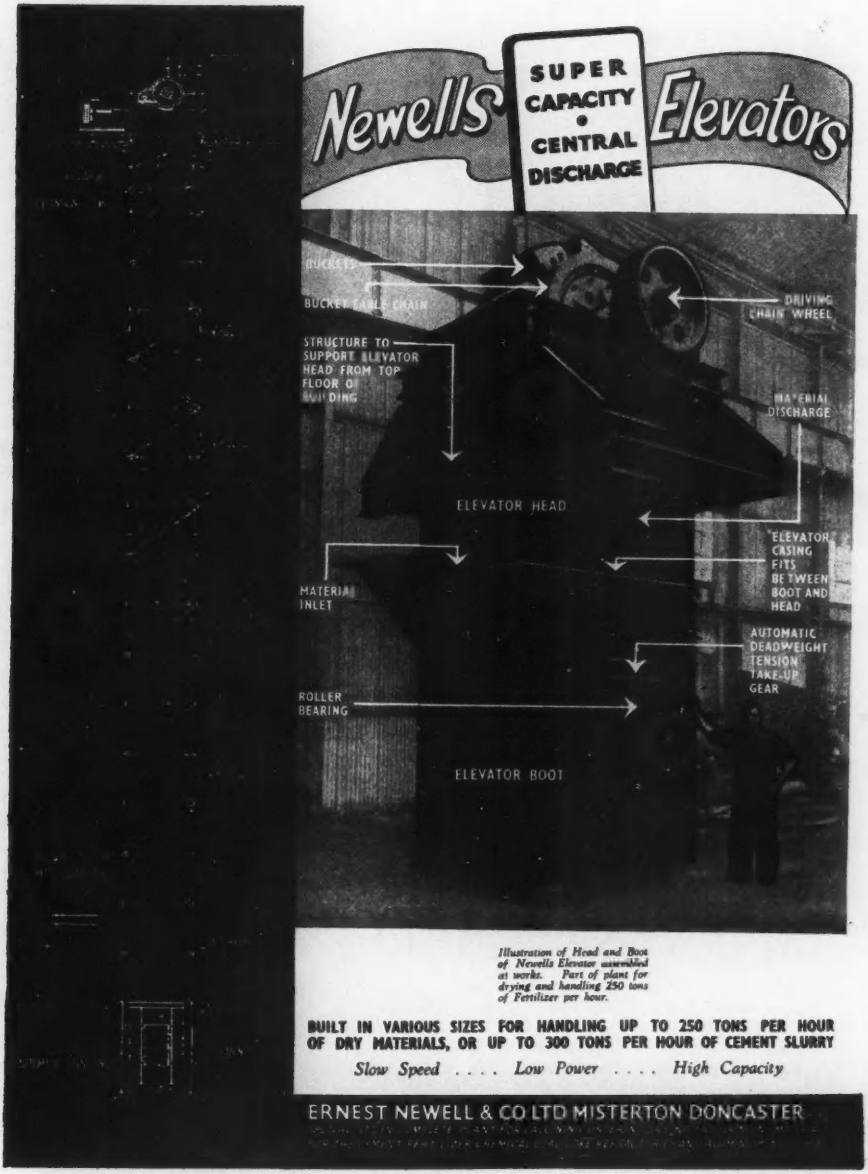

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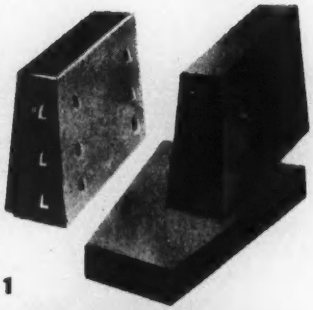
RADEX MAGNESITE BRICKS for KILN LININGS (ROTARY & SHAFT)

give the greatest refractory efficiency



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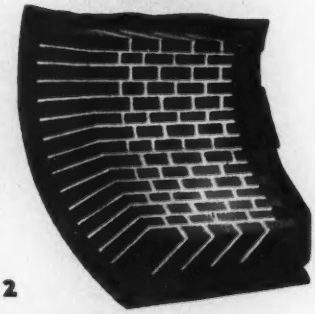

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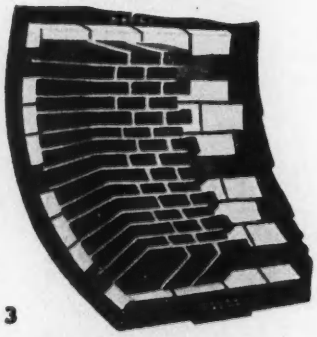

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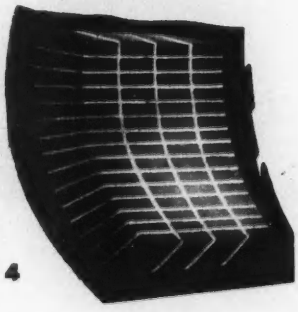

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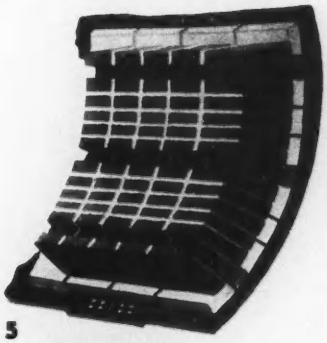

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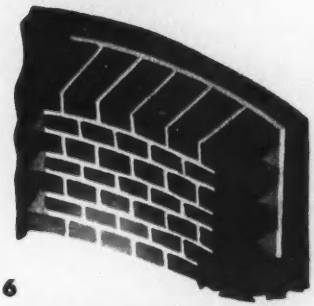

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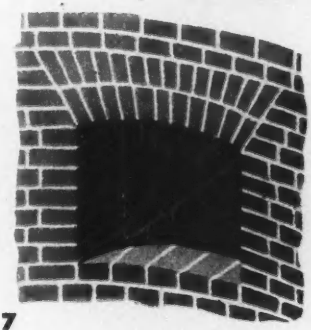

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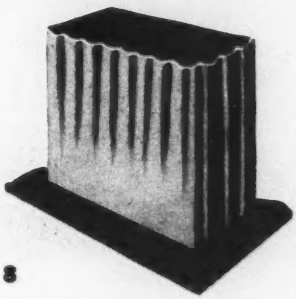

8

Standard Radex Bricks and methods of installation

RADEX-A: Fired special magnesite brick, highly basic, well-known for its excellent refractoriness and resistance against temperature shocks. Possesses great cold crushing strength and resistance against the action of basic slags. Has stood the test during more than 3,000 campaigns in burning zones and discharge ends of rotary and shaft kilns.
Metal sheets, or alternatively special magnesite mortar mixed with silicate of soda, are recommended for jointing.

RADEX-SK: Chemically-bonded, metal-cased, magnesite-chrome brick, resistant against temperature fluctuations and the action of basic slag. Highly refractory. Possesses excellent cold crushing strength and mechanical strength. Great accuracy to dimensions. Requires no jointing. Mainly used in burning zones of rotary kilns.

RADEX-MU: Chemically-bonded magnesite-chrome brick (without metal casing). Same properties as Radex SK brick. Is mainly used in burning zones of rotary and shaft kilns. Metal sheets or special magnesite mortar mixed with silicate of soda are recommended for jointing.

RADEX-EZ: Fired magnesite-chrome brick, highly refractory, resistant against the action of basic slag. Possesses great cold crushing strength, resistance against temperature fluctuations, low thermal conductivity. Promotes the formation of clinker coating. Is mainly used in intermediate and clinker zones of rotary kilns. Metal sheets or special magnesite mortar mixed with silicate of soda are recommended for jointing.

RADEX-B: Fired special magnesite brick, made of electrically-fused magnesite without extraneous admixtures. Resistant against temperature fluctuations and the action of basic slag. Possesses excellent refractoriness, great cold crushing strength, and resistance against abrasion. Mainly used in burning zones of cement kilns, particularly in kilns producing white Portland cement, but is also used for feeding zones of shaft kilns.

COMPLETE TECHNICAL DETAILS AND PRICES FROM

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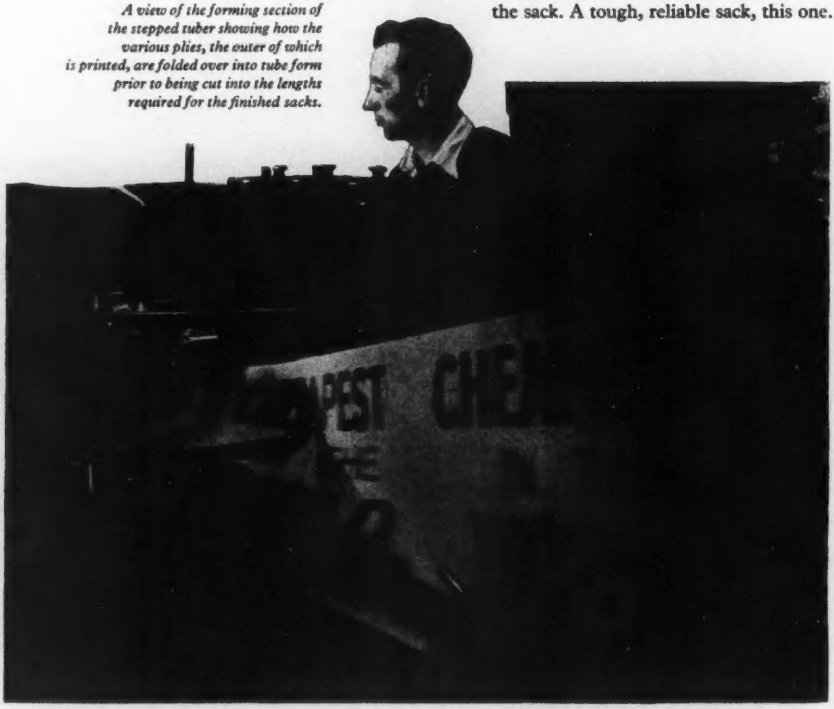
BOWATERS PACKAGING

Stepped for Strength

As the first large-scale users of multiwall sacks, the cement industry has always been of special interest to Bowaters. Thus a regular feature of Bowater production for packaging cement and allied products is the "stepped end" sack, a pasted valve sack in which the plies overlap at top and bottom. The advantages of this method are reliability of adhesion and flexibility. The overlapping of the plies gives uniform thickness at the bottom, hence uniform thickness all over the sack. A tough, reliable sack, this one.

A view of the forming section of the stepped tuber showing how the various plies, the outer of which is printed, are folded over into tube form prior to being cut into the lengths required for the finished sacks.



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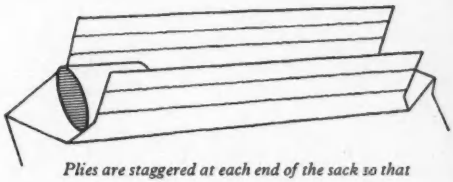
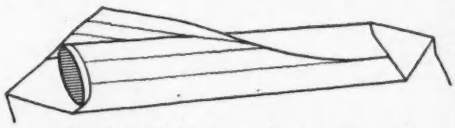


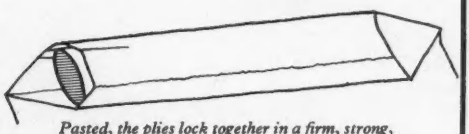
Plies are staggered at each end of the sack so that

2

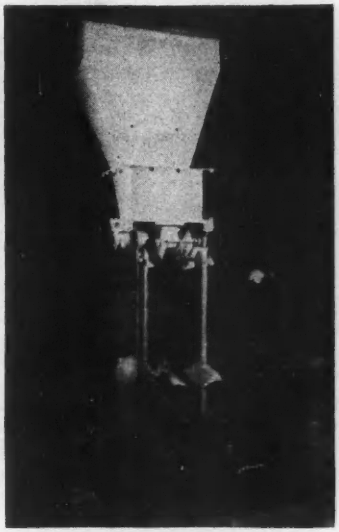


when they are folded over, each ply overlaps itself.

3



Pasted, the plies lock together in a firm, strong, flexible bond—stronger than the old single-ply closure and more flexible in use. Note the built-in valve sleeve.



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Low-output ground rock products are easy to handle with the Bowater 7000 F.C. Packer. With simultaneous action it weighs and packs, in cwts., at speeds varying from 3-12 tons an hour, depending on the actual product. Manual control is simple. The sack holder is mounted on an Avery pre-determined scale, giving clear weight indication.

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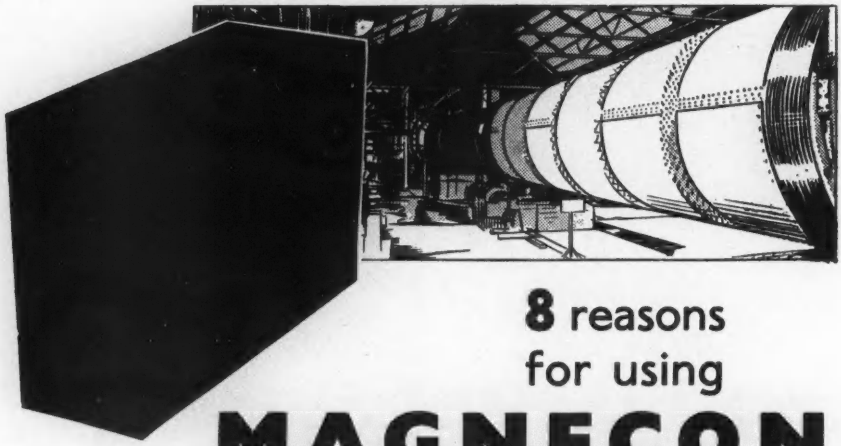

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3 Will not disintegrate due to thermal contraction.
4 Have better than average hydration resistance.
5 Will build up coating very rapidly.
6 Are able to maintain coating during operation and during shut-downs.
7 Will give increased cement production per lining.
8 Will save maintenance time and cost.

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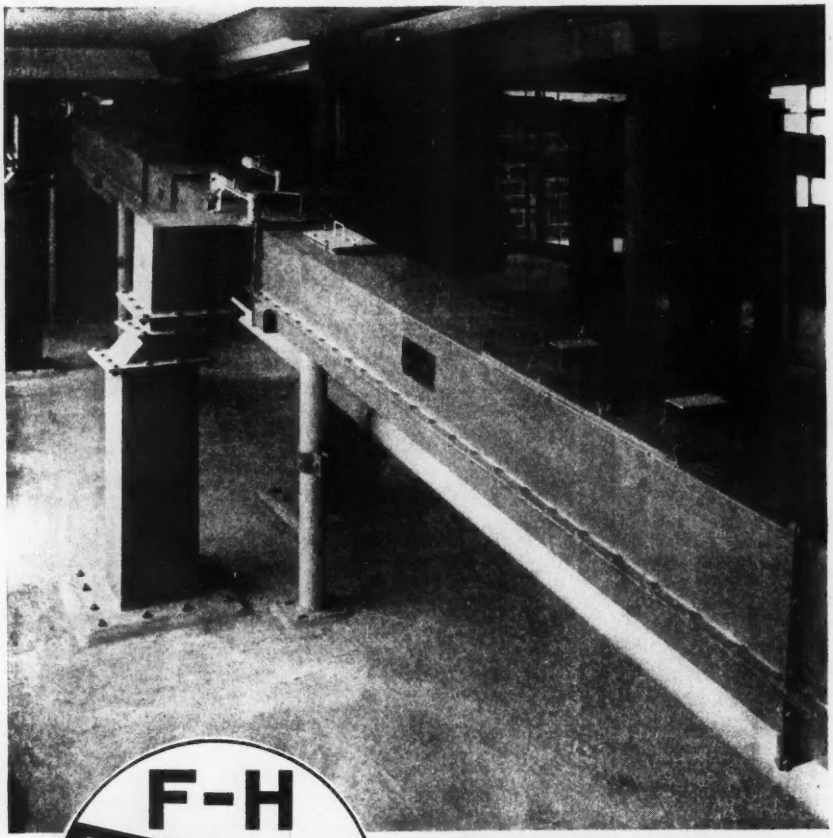

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A very flexible installation eminently suitable for conveying from cement mills to elevators, and for efficient silo discharge and bulk loading and unloading of road and rail containers. Only the material moves in the F-H AIRSLIDE. It consumes little power—only that required for a small volume of air at low pressure—and there is no danger of accidents.

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(Sole licensees for the manufacture and sale of Fuller equipment in Great Britain)

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Every year sees additions to the number of Cement Works using the " Visco-Beth " system of Automatic Dust Collection. In these plants, waste has been eliminated, output increased, costs reduced, and the Dust Nuisance permanently overcome. Material previously lost in the form of dust at crushers, conveyors, and other machines is now recovered as saleable product. " Visco-Beth " Automatic Dust Collectors have a recovery efficiency of practically 100%, are simple, positive in action, and will operate for long periods with only occasional unskilled attention.

Part of a "Visco-Beth" Automatic Dust Collector.

" Visco " Collectors are also giving excellent results in lime works and other plants where dust is produced in quantities.

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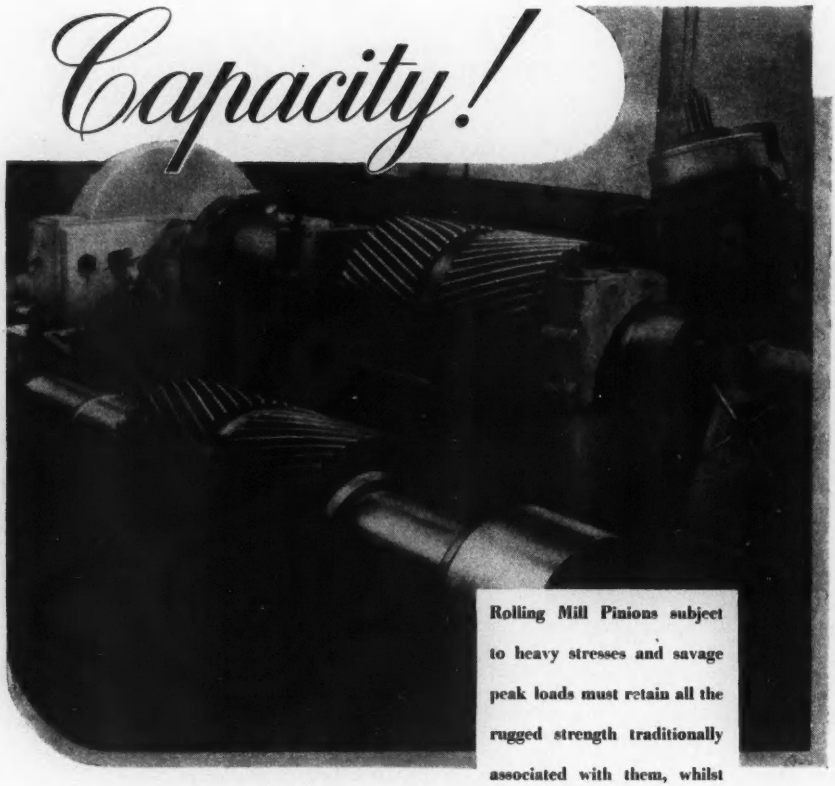
Capacity!



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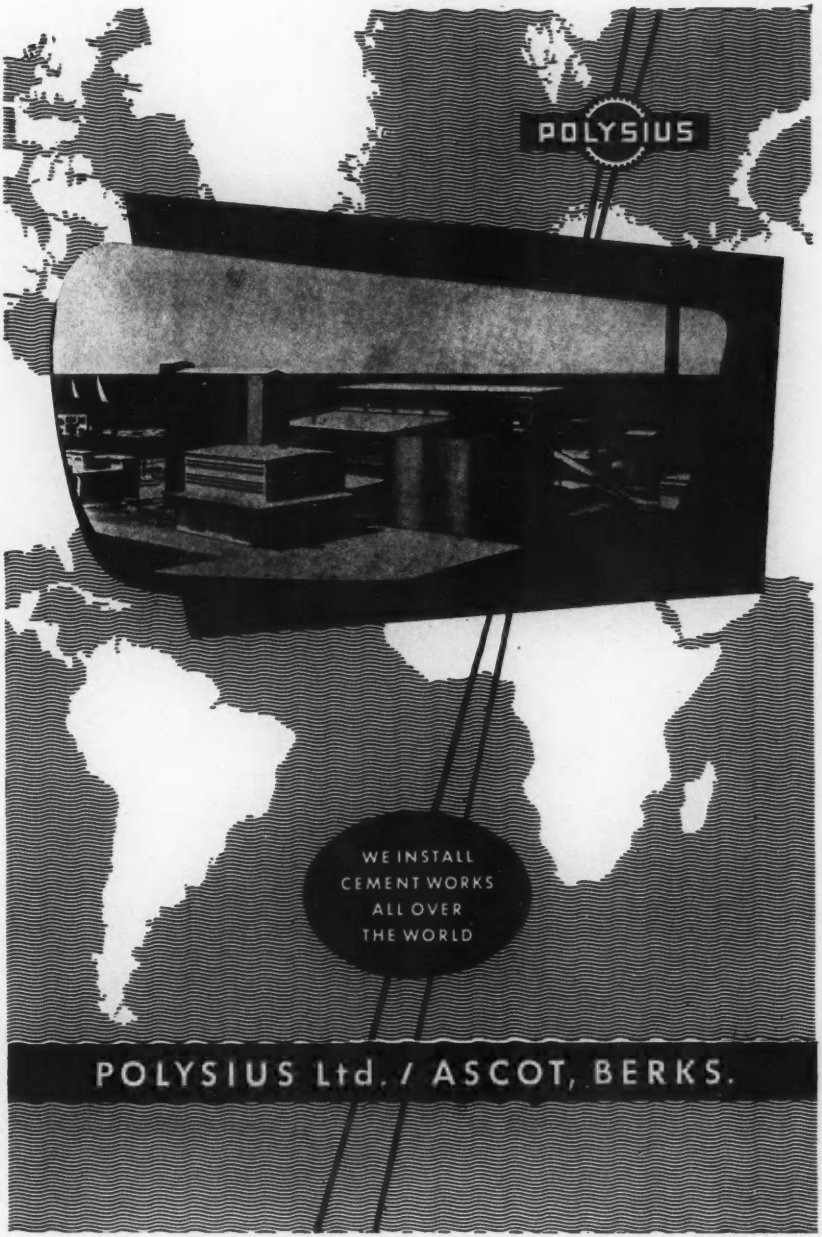
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WE INSTALL
CEMENT WORKS
ALL OVER
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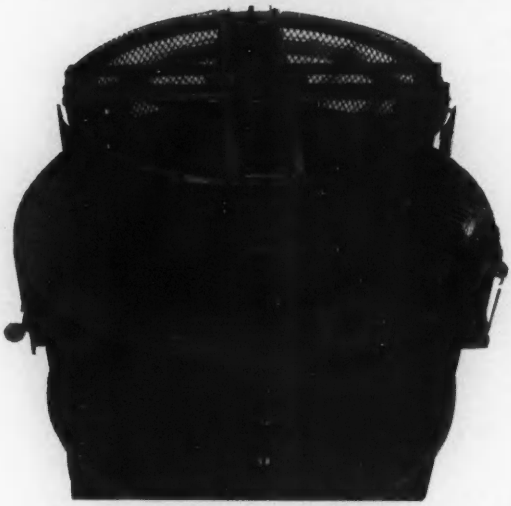
CIRCULAR DUST COLLECTORS



The Mechanism shown above is standard and is robustly built for 24-hours' operation.

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CEMENT & LIME WORKS

High Alumina bricks and special shapes for Rotary and Shaft kilns. Full details available on request.

Alite	Alumina	Refractoriness
No. 1	69-72%	CONE 37-38
B.1	62-64%	36
B.	57-59%	36
D.	39-42%	33

High-Temperature Insulating Bricks.
"PEER" Air-Setting Refractory Cements.
"R" Quality Firebrick for lower temperature work and resistance to abrasion.

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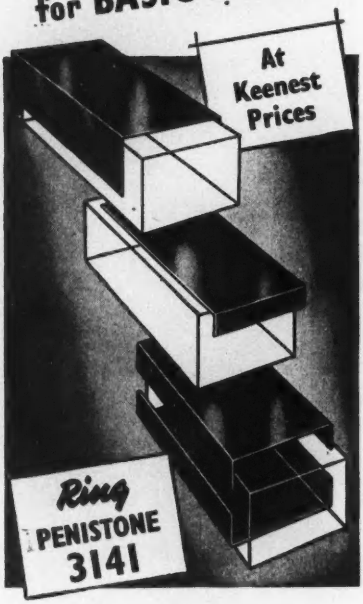

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DUTY: 111,000 c. ft. of gases per min. at 415°F. against 5.35" twg.

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for
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Write for the fully illustrated Booklet No. 25/31

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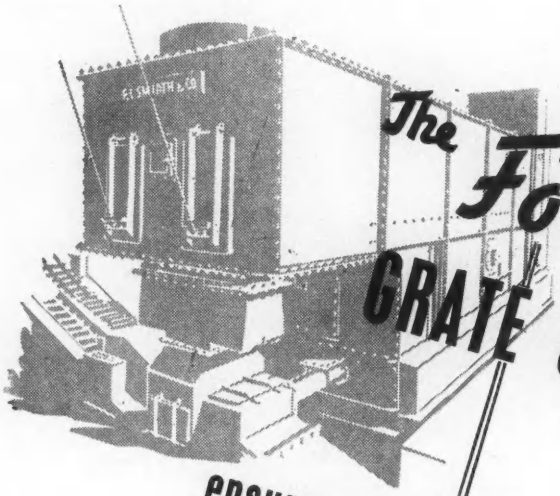

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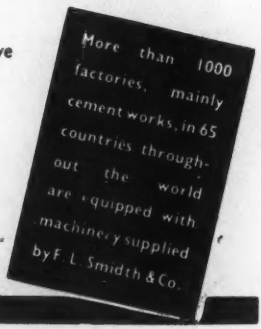
ensures flexible kiln operation...

The amount of air penetrating the bed of the FOLAX GRATE COOLER can be adjusted independently of the amount of air required for the burning in the kiln, and the cooler and kiln speeds are independent of one another.

Other features are efficient heat recuperation, air quenching, effective cooling permitting immediate grinding, low head room, low power consumption and small maintenance cost.

The FOLAX GRATE COOLER—the cooler with horizontal grate and positive conveying of the clinker—is supplied by :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PUBLISHED ALTERNATE MONTHS. PRICE 1s. A COPY. ANNUAL SUBSCRIPTION 6s. POST FREE. $1.30 IN CANADA AND U.S.A.

PUBLISHED BY
CONCRETE PUBLICATIONS LIMITED
14 DARTMOUTH STREET, LONDON, S.W.1.
TELEPHONE: WHITEHALL 4581.
TELEGRAPHIC ADDRESS: CONCRETIUS, PARL, LONDON.

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VOLUME XXIX. NUMBER 6. NOVEMBER, 1956

New Accelerated Test for Cement.

ACCELERATED tests of the rate of hardening of cement by means of steam curing are generally considered to be unsatisfactory because cements of different mineralogical composition react differently, with the result that the early strength of specimens cured by steam is not always a reliable guide to their strength at later ages.

Tests carried out by A. V. Vitkup and reported in "Tsement" (1954, No. 1) were based on a modified mild steam-curing cycle of short duration, and no significant difference was noticed in the speed of hardening of cements of various

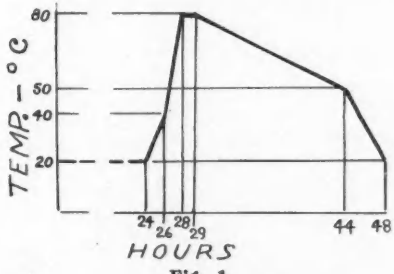


Fig. 1.

mineralogical compositions. *Fig.* 1 shows the temperatures used in this method of testing. The duration of the process at the maximum temperature (not higher than 80 deg. C.) is one hour only. It is believed that this process of heating and cooling prevents the variable effects of the usual methods of steam curing. A strictly controlled cycle of curing is obtained by automatic control of the temperature and the steam. Mortars are tested because cement paste is particularly sensitive to high temperatures, and moreover the testing of cement paste is not related to the conditions under which the cement is used.

In the normal method of steam curing, the conversion of the results of the accelerated test to the normal strength is in the form of a general constant for all types of cements and this constant is increased by a factor depending on the ratio of the strengths of the steam-cured specimens and normally-cured specimens at 24 hours. In Vitkup's method, however, a coefficient is used to obtain the strength at 28 days from the accelerated test for a given type of cement and also for the cement made at any given works. The new method is as follows.

Specimens are prepared by the standard procedure of the Russian standard G.O.S.T. 310-41. For the first 24 hours (48 hours for slag Portland cement) the cubes are cured in air in the usual manner. The cubes are then subjected to steam curing (*Fig.* 1). First the temperature of the oven, with an atmosphere of

TABLE I

Type of Cement	No. of Samples	Average (per cent.)	Deviation from Average (per cent.)	
			−	+
Works No. 1 - Portland grades 200, 250 & 300	3	0·70	7·9	2·8
Works No. 2 - " " 250 & 400	4	0·71	10·0	4·2
Works No. 3 - " " 300 & 400	4	0·76	4·0	5·2
Works No. 4 - " " 400 & 500	19	0·76	7·9	6·5
Works No. 5 - " " 400 & 500	5	0·75	6·6	6·6
Works No. 6 - Slag Portland	2	0·78	3·6	3·6
Works No. 7 - " "	3	0·82	2·5	2·5
Imported Portland	3	0·78	5·0	5·0

Relation between Strength of Steam-cured Specimens at 24 Hours and Specimens Cured by Standard Methods at 48 Hours.

steam, is raised to 80 deg. C. at the rate of 10 deg. C. per hour for the first two hours and at 20 deg. C. per hour for the next two hours. The temperature of 80 deg. C. is maintained for one hour and the oven is then cooled to 50 deg. C. at the rate of 20 deg. C. per hour. At 50 deg. C. the heating is discontinued and the cubes are allowed to cool for four hours before being tested. This curing is done automatically in a chamber which is combined with a thermograph. The heating elements are incorporated in the bottom of the chamber and have a power of 960 watts at 38 volts. An arrangement is used by which impulses from a thermocouple in the curing chamber are transmitted to a control unit that adjusts the heat.

During a period of two years the reliability of the method was ascertained by testing various grades of cement (*Table* I). There were considerable differences in the chemical composition of the cements; for example the cements from works No. 2 contained 22 to 38 per cent. of alite; cement from works No. 4, 55 to 77 per cent. of alite; cement from the works No. 3, 15 to 30 per cent. of belite; cement from works No. 7, 30 to 44 per cent. of belite.

All the samples were subjected to standard tests and to tests after steam curing by the foregoing procedure. From a comparison of the results of standard and accelerated tests conversion coefficients were derived for cements from the various works, and the possible limits of variation were defined as a function of

the differences in the mineralogical composition. To obtain a measure of the reproducibility of the test results, three samples of each cement were tested. The author concludes that this form of accelerated testing gives results that (except for insignificant variations) can be expressed as a proportion of the standard compressive strength. This conclusion is confirmed by the data in *Table* I. This method can also be used for high-grade cements. The unsuitability of high-grade cements for steam curing because of their mineralogical composition is true only for very severe and prolonged cycles of steam curing. If a short and mild cycle is used the effects of the mineralogical composition disappear. *Table* I shows that deviation from the mean value of the ratio of the strength of steam-cured specimens to the strength at 28 days does not exceed 10 per cent. for any one works.

Effect of Fluorides on Tricalcium Aluminate at High Temperatures.

THE effect of the addition of 5 per cent. of fluorides of calcium, sodium, and potassium on the behaviour of tricalcium aluminate at clinkering temperatures has been investigated in the U.S.S.R. by means of ionizing X-rays by Messrs. Toporov, Volkonskij and Sadkov and the result is reported in " Tsement " (1955, No. 4).

The writers state that potassium fluoride (KF) begins to affect tricalcium aluminate at a temperature of 800 deg. C., when it decomposes, producing pentacalcium aluminate and free lime as the main products. The following maxima (Armstrong units) in the ionization curve of tricalcium aluminate (800 deg. C.) were noted as corresponding to the formation of the pentacalcium aluminate: 4·99, 3·20, 2·81, 2·71, 2·43, 2·19, 1·46, and 1·40. The formation of free lime was identified at wavelengths of 2·76, 2·39, and 1·69 Armstrong units.

Thermal decomposition of tricalcium aluminate occurs only at temperatures lower than 1300 deg. C.; at higher temperatures the products recombine to return the tricalcium aluminate. This is assumed from the fact that the curves obtained at 1300 deg. C. and 20 deg. C. are identical, thus indicating that there is no difference in the structure of tricalcium aluminate at these two temperatures. A similar behaviour was observed in the case of the addition of sodium fluoride. The tricalcium aluminate begins to decompose at 800 deg. C., producing pentacalcium aluminate and free lime. At 1400 deg. C. the decomposition products recombine.

The addition of calcium fluoride (CaF_2) has an action comparable to that of the fluorides of sodium and calcium. In this case, however, the decomposition of tricalcium aluminate starts at 1000 deg. C. and the products recombine at 1400 deg. C.

Differences in the fluxing action of the fluorides on tricalcium aluminate is ascribed to the different degrees of volatility of the fluorides of sodium, potassium, and calcium. Experimental evidence was also found for the stability of tricalcium aluminate in the temperature range 20 deg. C. to 1500 deg. C. when no fluorides were present.

XUM

The System Lime, Silica and Water.

AN account of an investigation of the phase equilibria in the system lime, silica and water at 180 deg. C., by Mr. Richard B. Pepler, is given in the Journal of Research of the U.S. National Bureau of Standards for April 1955. Only two stable ternary compounds were found, namely, xonotlite and hillebrandite. Two other stable binary compounds found were α-quartz and $Ca(OH)_2$. The metastable equilibrium curves of gyrolite and of a silica gel were determined approximately. The results suggested several other metastable compounds. Treating oxide mixtures with CaO to SiO_2 ratios of 0·1 to 4 with steam for six months at 180 deg. C. yielded xonotlite and hillebrandite as the only hydrosilicates. The following is the author's note on the investigation.

The 180 deg. C. isotherm of the system $CaO\text{-}SiO_2\text{-}HO_2$ appears to be more complex than the room-temperature isotherm. Although the compounds at 180 deg. C. are definitely crystalline and give reasonably sharp X-ray patterns, it is difficult to identify them. The number of compounds that can exist metastably in this system appears to be at a maximum at or near 180 deg. C.

When the initial CaO to SiO_2 molar ratio is 0·8 or less and silica is initially a solid phase, the two combine to form metastable gyrolite. It then transforms into xonotlite with a rapidity that apparently depends on the CaO to SiO_2 molar ratio, as evidenced by the fact that the proportion of xonotlite increases in the reaction products with increasing CaO to SiO_2 ratio. At a low CaO to SiO_2 ratio the transformation is not complete at the end of twelve days. Other phases may first form that are in turn metastable with respect to gyrolite. In the presence of excess reactive silica, however, minor phases apparently exist only transitorily.

When the initial molar CaO to SiO_2 ratio was 1·05 (and silica gel was the solid phase), the only product at the end of thirteen days was xonotlite. It is possible that gyrolite first formed and then converted to xonotlite, because a mixture of gyrolite and xonotlite converted in ten days to xonotlite. It was established conclusively that xonotlite, and not gyrolite, is the stable phase.

Certain analogies can be drawn between the phase equilibria in the system $CaO\text{-}SiO_2\text{-}H_2O$ at room temperature and those at 180 deg. C. At room temperature available evidence indicates that only two stable ternary compounds, CSH I and C_2SH II, a monocalcium and a dicalcium silicate hydrate, exist. These are analogous, as regards CaO to SiO_2 ratio, to xonotlite and hillebrandite, which were found to be stable at 180 deg. C.

At room temperature the compound CSH I has been found to vary in CaO to SiO_2 ratio from 0·8 to 1·5, and the compound C_2SH II to vary from 1·4 to 1·9. All compositions from CaO to SiO_2 ratio up to 1·5 gave xonotlite, and higher CaO to SiO_2 ratios gave hillebrandite. The CaO to SiO_2 ratio of the solid reaction products was not determined in this investigation. Kalousek, Logiudice, and Dodson, however, prepared synthetic hillebrandite, as well as the α- and γ-dicalcium silicate hydrate, in the range 175 deg. to 250 deg. C. in which the

CaO to SiO_2 molar ratios varied from 1·5 to 2·4 and possibly extended to 3 for synthetic hillebrandite (β-hydrate). For each hydrate almost identical X-ray patterns were obtained over the range of varying CaO to SiO_2 ratio. This is directly analogous to that found at room temperature, where a varying CaO to SiO_2 ratio, within the limits mentioned, does not affect the X-ray patterns.

Several previous investigators have prepared dicalcium silicate hydrate ($10CaO{\cdot}5SiO_2{\cdot}6H_2O$) and it has been isolated in steam-cured mortars. This suggests that it might be the stable dicalcium silicate hydrate at 180 deg. C. The present investigation, however, indicates that hillebrandite is the stable dicalcium silicate hydrate. Kalousek, Logiudice, and Dodson found that the α-hydrate, prepared at 175 deg. C., began to connect to the β-hydrate (hillebrandite) when the temperature was raised. Their work indicates that many variables, such as type of silica and condition of mixing, helped to determine the hydrate produced, so that they were not able to assign definite ranges of temperature over which the various hydrates are stable. The same authors found that, at 175 deg. C., when the CaO to SiO_2 ratio fell below 1·8 xonotlite appeared. This is in accord with the results obtained in the present investigation.

Recent work of Heller and Taylor indicates that hillebrandite is the stable dicalcium silicate hydrate at 180 deg. C. They found that $Ca(OH)_2$ and silica in 2·1 ratio at 180 deg. C. for 30 days gave hillebrandite. The α-hydrate was formed below and the γ-hydrate above 180 deg. C. These results were not conclusive, however, because in another experiment they obtained all three hydrates. The present investigation also is in accord with other recent work of Heller and Taylor, which demonstrates that CSH I and afwillite are metastable at 180 deg. C.

From the group of experiments in which the initial molar CaO to SiO_2 ratio is 1·5 to 3, it is apparent that no stable compound more lime-rich than dicalcium silicate hydrate is formed. The hydrate $3CaO{\cdot}SiO_2{\cdot}2H_2O$ was prepared by Flint, McMurdie, and Wells at and above 200 deg. C. In one experiment a few weak lines in the X-ray pattern indicated the presence of this hydrosilicate, but they resembled the lines of $Ca(OH)_2$ too closely to prove the existence of the hydrosilicate at 180 deg. C. The same authors found that $CaO{\cdot}SiO_2{\cdot}H_2O$ formed at 150 deg. C. and xonotlite at 175 deg. C. from a CaO and SiO_2 mixture of 1 : 1 molar ratio. This would indicate that the compound $CaO{\cdot}SiO_2{\cdot}H_2O$ is metastable with respect to xonotlite near 180 deg. C. The results of the present investigation are in accord. However, Flint, McMurdie, and Wells found that the compound $4CaO{\cdot}5SiO_2{\cdot}5H_2O$ formed between 150 deg. C. and 275 deg. C. and persisted in this range from seven to 42 days. This suggests that it is a stable phase at 180 deg. C. because it was found to transform to xonotlite only at 300 deg. C. In the present investigation, this compound was found to be metastable with respect to xonotlite at 180 deg. C. Flint, McMurdie, and Wells used lime-silica gels in their experiments, and these gels were steamed out of contact with the liquid

phase. Apparently, the rates of reaction of these materials are different, depending on whether they are in contact with the liquid or vapour phase. In the present investigation, for example, the products after hydrothermal treatment of oxide mixtures for six months had about the same degree of crystal growth and reaction as had corresponding liquid-contact experiments in one to two weeks. In the experiments from supersaturation the products of one experiment were the compounds $4CaO{\cdot}5SiO_2{\cdot}5H_2O$ and $CaO{\cdot}SiO_2{\cdot}H_2O$ and xonotlite, with respect to which the first two are evidently metastable.

The results of the present investigation are in accord with those of Flint, McMurdie, and Wells as regards the silica-rich compounds. These authors found gyrolite at 150 deg. to 400 deg. C. and xonotlite from 175 deg. to 390 deg. C. and were unable to prepare okenite in this temperature range.

Several properties of the solid phases of this system used qualitatively in this investigation might, in principle, be used to estimate quantitatively the rate of reaction. These include refractive index, dye absorption, DTA curves and X-ray patterns of the products before and after DTA heat treatment.

Automatic Control in Cement Works.

It is claimed that automatic controls not previously used in the cement industry have been applied to a new kiln, 390 ft. long by 11 ft. diameter, recently installed by the F. L. Smidth Company at the dry-process works of the Louisville Cement Company at Speed, Ind., U.S.A. According to "Rock Products" for May, 1956, features of the kiln include automatic control of the air required for combustion and of the natural-gas fuel.

A sample of the gases leaving the kiln is passed through an oxygen analyser. The air supplied is usually 1 or 2 per cent. more than is required for complete combustion and a damper on the induced-draught fan is automatically adjusted by a motor to maintain the correct amount of air. This damper is also interlocked with the fuel supply in order to ensure that there is sufficient air for the amount of fuel being used. Variations of the temperature of the clinker cause a pyrometer to operate a motor which opens or closes a valve and thereby adjusts the supply of fuel.

Devices have been installed for proportioning the shale and limestone; these controls are connected to the motor driving the mill so that sufficient material is fed to the mill as will maintain it at full capacity. Each cement silo has two outlets, one for the supply of loose cement and the other for cement to the packing machine. The packer automatically controls the supply of cement from the silos, and 500 bags are filled in twenty-three minutes. A retractable conveyor is used to transfer the bags to lorries. It is claimed that the labour cost of packing has been reduced by from 30 to 40 per cent. by this equipment.

U.S.A. Standards for Cement.

THE latest standards for cement of the American Society for Testing Materials are given in " A.S.T.M. Standards on Cement " issued by the Society and dated October, 1955. The price is 2.75 dollars. Although the last issue is dated as recently as May, 1954, substantial revisions have been made. The tentative methods of determining sodium oxide and potassium oxide by flame photometry and of determining the time of setting of hydraulic cement in mortar are omitted, and appendixes are added on analytical balances and weights, cement testing, references to the literature of Portland cement, and a method of determining the content of Vinsol resin air-entraining agent in cement.

Determination of Content of Vinsol Resin.

The method described for determining the content of Vinsol resin in Portland cement is a modification of the Clark volumetric method as developed by the Hercules Powder Company, and the principle is as follows.

Hydriodic acid reacts with Vinsol resin forming methyl iodide, which is distilled into a bromine solution. The bromine reacts with the methyl iodide, forming iodine monobromide which gives iodic acid when water is added. The excess bromine is destroyed with formic acid. Iodic acid oxidises potassium iodide to free iodine. The free iodine is titrated with standard sodium thisulphate, thereby obtaining a measure of the methoxyl content of the sample.

When hydriodic acid (HI) acts on compounds containing alkoxyl groups, alkyl iodides are formed. For compounds having methoxyl and ethoxyl groups, methyl iodide (boiling point 42 deg. C.) and ethyl iodide (boiling point 72 deg. C.) are formed. At the temperature of boiling HI (126 deg. C.), methyl iodide and ethyl iodide are both distilled. Alkyl iodides boiling at temperatures above the boiling point of HI are not distilled.

The reaction between Vinsol resin and HI is :

$R(OCH_3)_x$	+	xHI	→	xCH_3I	+	$R(OH)_x$
Vinsol resin		Hydriodic acid		Methyl iodide		Unknown alcohol

$R(OCH_3)_x$ represents the compound in Vinsol resin responsible for the determination of methoxyl. The radical $(OCH_3)_x$ symbolises an unknown number of methoxyl groups attached to the remaining (probably unknown) part of the molecule represented as R.

In determining the alkoxyl content of Vinsol resin, phenol (C_6H_5OH) is added to the reaction flask with HI to act as a solvent; it probably also aids in the reaction. A boiling time of 30 minutes is sufficient. Water and red phosphorus are used in the trap to absorb and react with any HI or free iodine swept out of the reaction flask. If the HI and free iodine were to reach the absorbers, high values for methoxyl would result.

In the absorption tubes, the methyl iodide swept over by a stream of CO_2 or nitrogen is absorbed in an acetic acid solution of potassium acetate to which a little bromide is added. The reaction is

$$\underset{\text{Methyl iodide}}{CH_3I} + \underset{\text{Bromine}}{Br_2} \rightarrow \underset{\text{Methyl bromide}}{CH_3Br} + \underset{\text{Iodine monobromide}}{IBr}$$

The potassium acetate maintains the proper pH for the reaction to take place. Insufficient bromine in the absorbing tubes causes low and erratic results.

On transferring the contents of the absorption tubes to a flask containing water and sodium acetate, the following reaction takes place:

$$IBr + 2Br_2 + 3H_2O \rightarrow \underset{\text{Iodic acid}}{HIO_3} + \underset{\text{Hydrobromic acid}}{5HBr}$$

The acetic acid, potassium acetate, sodium acetate, and water neutralise the HBr formed and keep the pH at the proper level for the oxidation-reduction reaction to be completed. The excess of bromine must be removed or it will react with the KI added subsequently, liberating iodine and causing high results. The excess of bromine is destroyed by adding an excess of formic acid, as follows:

$$Br_2 + \underset{\text{Formic acid}}{HCO_2H} \rightarrow 2HBr + \underset{\text{Carbon dioxide}}{CO_2}$$

In the sodium acetate-acetic acid-water solution, formic acid reduces bromine but does not reduce the H_2O_3 present.

To get a measure of the HIO_3 formed, H_2SO_4 (strong mineral acid) and KI are added. Part of the KI, equivalent to the HIO_3 present, is oxidised to free iodine, which is titrated with standard $Na_2S_2O_3$ solution as follows:

$$2HIO_3 + 10KI + 5H_2SO_4 \rightarrow 6I_2 + 5K_2SO_4 + 6H_2O$$

$$\underset{\text{Iodine}}{I_2} + \underset{\text{Sodium thiosulphate}}{2Na_2S_2O_3} \rightarrow \underset{\text{Sodium iodide}}{2NaI} + \underset{\text{Sodium tetrathionate}}{Na_2S_4O_6}$$

Vinsol resin consists substantially of the petroleum-hydrocarbon insoluble fraction of a coal-tar hydrocarbon extract of pine wood. The amount of 5·7 per cent. of methoxyl in Vinsol resin has been established. The methoxyl (OCH_3) content varies from 5 to 7 per cent. To determine this content, transfer 0·10 to 0·15 g. of the resin to the reaction flask and proceed in accordance with Section 5 (*b*) to (*d*) of A.S.T.M. Methods C 114–51 T. The titration requires 10 ml. or more of standard $Na_2S_2O_3$ solution. A burette larger than 5 ml. may be used. Multiply the volume by the methoxyl value of the solution and by 100 and divide by the weight of the sample to get the percentage by weight of methoxyl. The value of an exactly 1*N* $Na_2S_2O_3$ solution is 0·00517 g. of methoxyl per millilitre, but an approximately 0·1*N* solution is used for greater precision.

An average recovery of methoxyl equivalent to 83·5 per cent. of the Vinsol resin can be expected. There is no loss of methoxyl in the distillation and titration, but a loss of 16·5 per cent. is believed to result from partial decomposition or alteration of Vinsol resin when grinding the resin into the cement or when extracting the resin from the cement.

The amount of methoxyl in Vinsol resin-treated cement is only about 0·002 per cent., but its determination is made possible by the fact that for each methoxyl group six atoms of iodine are liberated. Since only 1 ml. to 2 ml. of 0·1*N* $Na_2S_2O_3$ is required, a microburette should be used.

The Cement Industry in India.

IN our July number a list was given of proposals for the erection of new cement works and the extension of existing cement works in India. The following additional applications for licences to establish new works have now been issued. The name and address of the applicant is given first, followed by the district in which the new works or the extension is to be built and the annual capacity.

Hindusthan Sugar Mills, Ltd., Golagokarannath, Dist. Kheri, U.P.—Dehra Dun, U.P. 200,000 tons.

Saurashtra Cement Works (Shri Nanjibhai), Kalidas Mehta, Porbandar.—Ranavav (Porbandar). 200,000 tons.

Associated Cement Co., Ltd., 121 Queen's Road, Bombay.—Yerraguntla (Andhra). 165,000 tons.

K.C.P., Ltd., 38 Mount Road, Madras.—Macherla, Guntur (Andhra). 150,000 tons.

Ashoka Cement, Ltd., Dalmianagar.—Dalmianagar (Bihar). 280,000 tons.

Orissa Cement, Ltd., Scindia House, New Delhi.—Rajgangpur (Orissa). 360,000 tons.

Dalmia Cement (Bharat), Ltd., Scindia House, New Delhi.—Dalmiapuram (Madras). 165,000 tons.

Associated Cement Co., Ltd., 121 Queen's Road, Bombay.—Sindri (Bihar), 170,000 tons; Lakhari (Rajasthan), 165,000 tons; Chaibasa (Bihar), 170,000 tons; Dwarka (Bombay), 115,000 tons; Kistna (Andhra), 65,000 tons.

Enquiries relating to these proposals should be addressed to the Export Services Branch, Board of Trade, room 732, Lacon House, Theobalds Road, London, W.C.1, telephone Chancery 4411, extension 693 (quoting reference ESB/16990/56).

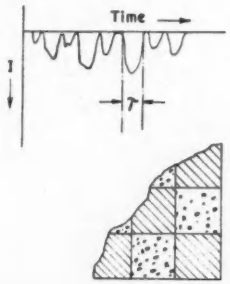
The Sir George Earle Industrial-Safety Trophy.

Applications may be submitted until January 31 for consideration by the Royal Society for the Prevention of Accidents for the 1957 award of the Sir George Earle trophy. This trophy—a silver Georgian inkstand—was presented to the Society last year by Sir George Earle, Chairman of The Associated Portland Cement Manufacturers, Ltd., for annual award for outstanding achievement in the prevention of industrial accidents. Competition for the trophy is open to all industries, companies, accident-prevention groups, branches of the Institution of Industrial-Safety Officers, and other bodies. For the year 1956 the trophy was awarded to H.M. Inspectors of Factories in recognition of their contribution to the prevention of accidents in industry for many years. Organisations desiring to be considered for the 1957 award of the trophy can obtain entry forms from the Royal Society for the Prevention of Accidents, 52 Grosvenor Gardens, London, S.W.1.

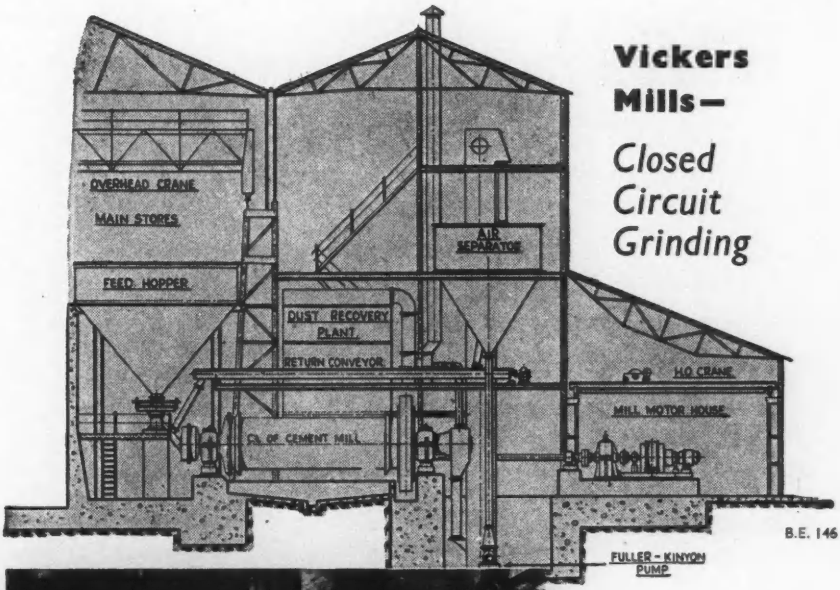
Analysis of Particle Size.

The following note relating to British Patent No. 707651, by D. A. Bell, is taken from the Bulletin of the National Research Development Corporation for February 1955. The invention originated at Birmingham University. In recent years a requirement has grown up for the accurate and rapid analysis of particulate matter by size and number for numerous purposes, for example, control of atmospheric dust, quality control of industrial powders, etc. In general, the particles concerned are of microscopic dimensions and cover wide size ranges (ca. 1:1000); consequently, for reasonably accurate analyses the measurement of a large number of particles is demanded.

Techniques of electrical pulse analysis are now well established so that the problem lies in obtaining electrical signals from samples of the matter under examination in some way related to the size. The analysis of these signals gives the required information.



In this invention a distribution of a sample of the particulate matter is illuminated by a regular pattern of light areas alternating with dark areas which is moved relatively to the field of view. The mean square of the intensity of the light transmitted (or reflected) is determined by some form of light-sensitive device such as a photo-electron multiplier. The spacing of the light pattern, which is like a chequers board (see figure), is so arranged that it is large compared with the mean particle size. Size analysis can be carried out by scanning at various speeds and measuring the square of the mean intensity; the curve so obtained is then compared with curves obtained with known distributions. This invention gives an indication of the size distribution but not an accurate count of the number of particles present. The graph in the figure shows the output of a photocell excited through a pattern of the type shown below containing random particles.



Vickers Mills—

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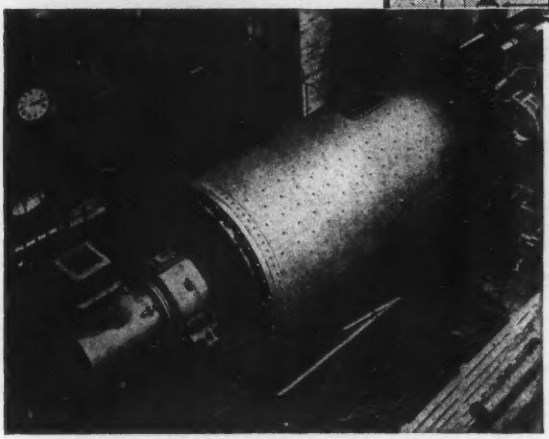

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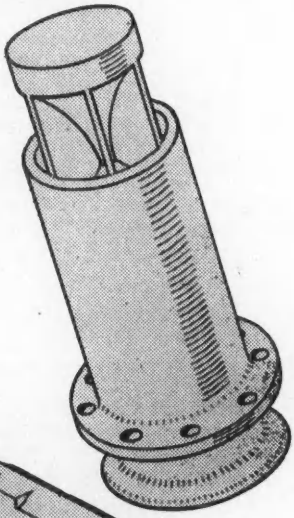

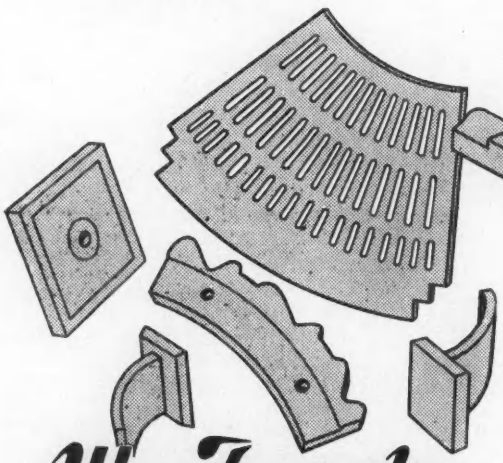

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Book Review.

"The Chemistry of Cement and Concrete." By F. M. Lea [London: Edward Arnold (Publishers), Ltd. Price 70s.]

This is a revised edition of the well-known volume formerly published under the authorship of Lea & Desch, which has been out of print for many years and has now been brought up to date by Dr. F. M. Lea, C.B.E., Director of the Building Research Station. The new edition follows the previous arrangement, but it has been largely rewritten and extended to include developments that have taken place since the work was first issued in 1935.

The Cement Industry in Formosa.

The production of cement in Formosa in the year 1955 was 590,000 metric tons, compared with 530,000 tons in 1954. Imports increased from 35,000 tons in 1954 to 46,000 tons in 1955. The estimated consumption of cement in 1956 is 700,000 tons. A new Lepol kiln being installed at the Chugung plant of the Taiwan Cement Corporation is expected to be in operation by the end of next June; its capacity will be about 100,000 tons a year. The Chia Hsin Cement Company was established in 1954 and is installing two Lepol kilns with total capacity 300,000 tons a year at Kan-Shan; it is expected that the first kiln will be in operation at the end of next July and the other by the end of 1958.

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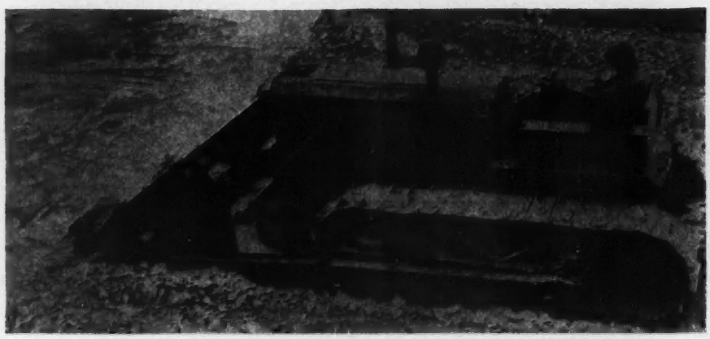

Fig. 1.

Proposed New Cement Works in Pakistan.

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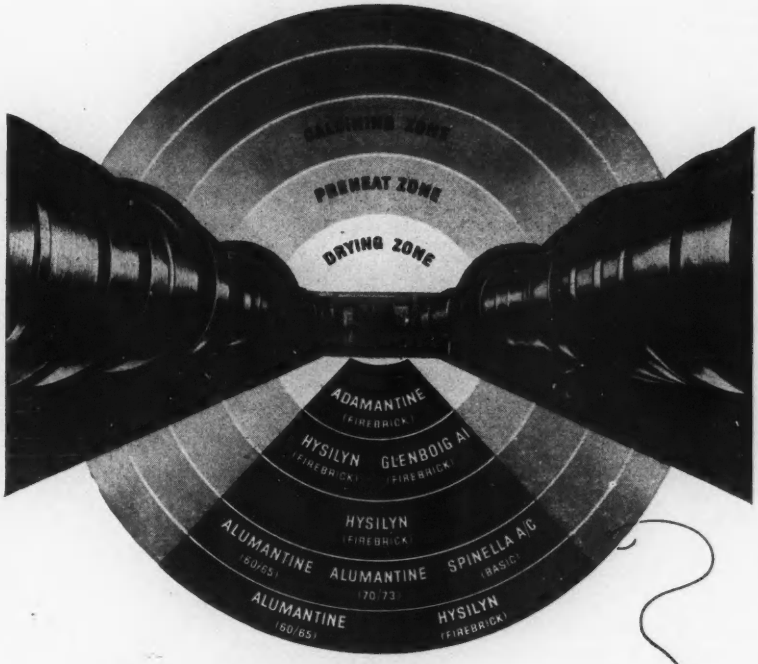

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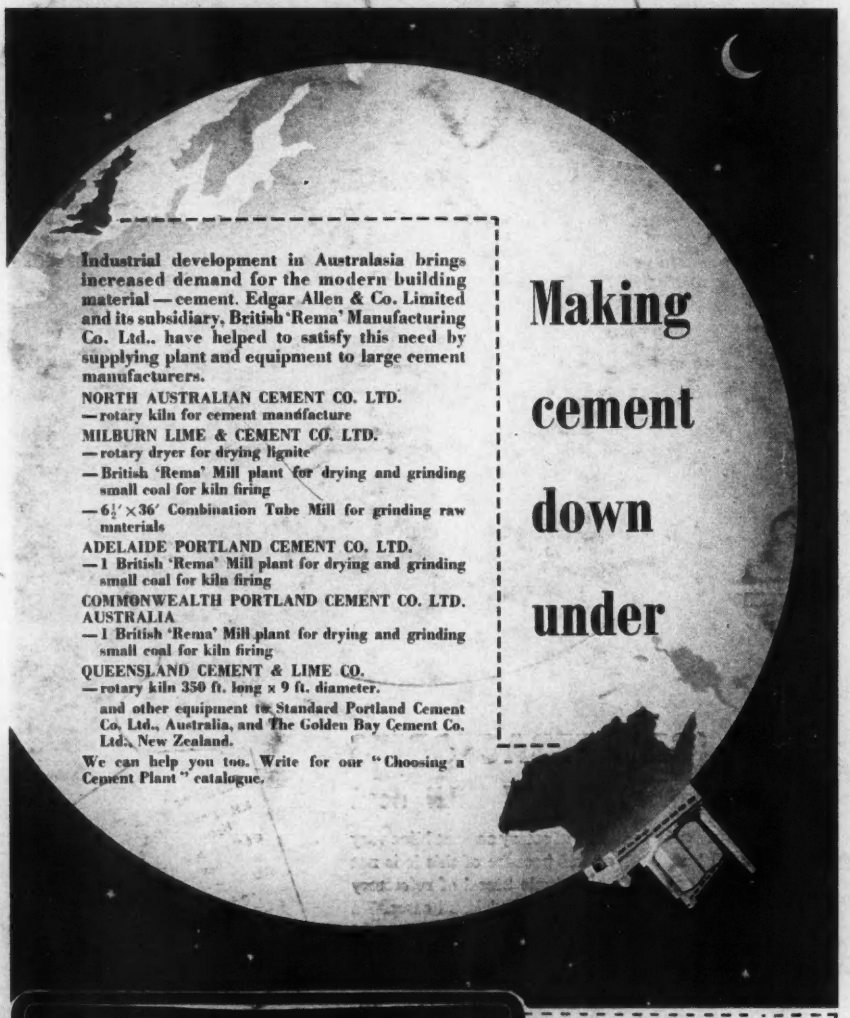

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Printed in Great Britain by CORNWALL PRESS LTD., 1-6, Paris Garden, Stamford Street, London, S.E.1.